

NISTTech

Integrated Optical Element and Faraday Cup

Enables simultaneous measurement of ion beam current and light manipulation for magneto-optical traps (MOT) and ion sources (MOTIS)

Description

This integrated optical objective and Faraday cup system improves the handling of a magneto-optical trap based ion source (MOTIS) by enabling the measurement of beam current and the manipulation of light guided along the same spatial axis. It measures energy spread which can be used to determine effects of chromatic aberrations of a given optical system. The axis in this device serves as a focus guide appropriate for a photo-ionizing laser to enable the MOTIS to be operated in a 'high-current' mode useful for creating small ion beam sources. The integrated device permits high numerical aperture optical imaging of the magneto-optical trap (MOT). It generates a control signal for feedback to enhance the stability of beam current in a MOTIS.

The system uses the charged particles emitted from MOTIS. The particles originate from a collection of laser-cooled ions in (MOT). Emitted electrons and ions move in opposite directions along an axis created by an electric field. The integrated device measures the current from the charged particle beam, permits retarding field energy analysis to measure longitudinal energy spread, and manipulates and transmits light.

Applications

- **Runtime monitoring of the ion beam current**
No interruption of ion beam operations.
- **Enhances beam stability**
Permits better control of a MOTIS.
- **Enables high numerical aperture optical imaging of MOT**
- **Produces small charge particle beams**
Enables the operation of a MOTIS in high current mode to produce these useful beams.

Advantages

- **Simple, compact operation**
Smaller footprint by integration two devices into one.
- **Combines Faraday cup and optical objective**
Enables functionality of both devices along same spatial axis of ion/electron beam.
- **Versatile**
Broad range of optical elements or systems can be used for imaging, laser-beam focusing and other light manipulating activities.

Abstract

This invention is a new device that integrates a Faraday Cup and an optical imaging element or system of elements. This integrated device resolves incompatibilities between Faraday cups, which are generally not transparent, and optical systems, which are generally not able to measure charged particle beam currents. This type of device is suitable for application in which optical access and manipulation of light is desired along an axis passing through a Faraday cup, as in a MOTIS. As a Faraday cup, the device can be used to measure charged particle beam current. One boundary of the cup is formed by a lens or other suitable optical element which can be used for manipulating light along the axis of the Faraday cup. The surface of the optical element interior to the cup is coated with a transparent conductor so as to establish the simultaneous functions of making charged particle beam current measurements and manipulating light for such applications as focusing or imaging.

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References

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Status of Availability

This invention is available for licensing exclusively or non-exclusively in any field of use.

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